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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/692,527

10/18/2000

Timothy Weidman

003984/DD/LOW K

7896

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7590

03/11/2003

APPLIED MATERIALS, INC.
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SANTA CLARA, CA 95050

EXAMINER

NOVACEK, CHRISTY L

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 03/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/692,527

Applicant(s)

WEIDMAN ET AL.

Examiner

Christy L. Novacek

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 December 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-36 and 38-43 is/are rejected.
- 7) ☒ Claim(s) 37 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 October 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 6.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the amendment filed December 12, 2002.

Response to Amendment

The amendment of claim 3 is sufficient to overcome the objection to claim 3 as it was stated in the previous Office Action. Therefore, this rejection is withdrawn.

The amendment of claim 13 and the amendment of the specification are sufficient to overcome the rejection of claims 13, 15, 22 and 37 under 35 U.S.C. 112, first paragraph as stated in the previous Office Action. Therefore, this rejection is withdrawn.

The amendment of claims 1, 2, 22 and 37 is sufficient to overcome the rejection of claims 1-22 and 37 under 35 U.S.C. 112, second paragraph as stated in the previous Office Action. Therefore, this rejection is withdrawn.

Drawings

Figures 1 and 3 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid **abandonment** of the application. The objection to the drawings will not be held in abeyance.

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

Claim 3 recites the limitation of the amorphous silicon carbide capping layer having a dielectric constant of “less than approximately 4.5”. However, the specification continually refers to the amorphous silicon carbide capping layer as having a dielectric constant of “approximately 4.5” (pg. 5, ln. 2; pg. 10, ln. 31-32; pg. 17, ln. 20-21; pg. 18, ln. 9; Abstract, ln. 17). The specification does not provide support for the silicon carbide capping layer to have a dielectric constant that is less than 4.5.

Claims 10 and 11 recite the limitation of the ELK film having a dielectric constant of “approximately 2.5 or less”. However, the specification defines an ELK (“extremely low dielectric constant”) film as a dielectric film that has a dielectric constant of less than 2.5, while “low dielectric constant materials” are films that have a dielectric constant between 2.5 and 3.0. Thus, the specification does not provide support for an ELK to have a dielectric constant of 2.5.

Claim 34 recites the limitation of the a-SiC layer having an etch selectivity of 40:1 to 1:1 with respect to the ELK layer. However, the only etch selectivity disclosed in the specification is an etch selectivity of the barrier layer with respect to the ELK material, which is recited as being “1:3 or lower” (pg. 12, ln. 25).

Claim Objections

Applicant is advised that should claim 10 be found allowable, claim 11 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3, 10, 11 and 34 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 3 recites the limitation of the amorphous silicon carbide capping layer having a dielectric constant of “less than approximately 4.5”. However, the specification continually refers to the amorphous silicon carbide capping layer as having a dielectric constant of “approximately 4.5” (pg. 5, ln. 2; pg. 10, ln. 31-32; pg. 17, ln. 20-21; pg. 18, ln. 9; Abstract, ln. 17). The specification does not provide support for the silicon carbide capping layer to have a dielectric constant that is less than 4.5.

Claims 10 and 11 recite the limitation of the ELK film having a dielectric constant of “approximately 2.5 or less”. However, the specification defines an ELK (“extremely low dielectric constant”) film as a dielectric film that has a dielectric constant of less than 2.5, while “low dielectric constant materials” are films that have a dielectric constant between 2.5 and 3.0. Thus, the specification does not provide support for an ELK to have a dielectric constant of 2.5.

Claim 34 recites the limitation of the a-SiC layer having an etch selectivity of 40:1 to 1:1 with respect to the ELK layer. However, the only etch selectivity disclosed in the specification is

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an etch selectivity of the barrier layer with respect to the ELK material, which is recited as being "1:3 or lower" (pg. 12, ln. 25).

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1, 10, 11, 17-19, 23, 26-29, and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. (US 6,140,221, previously cited) in view of Forbes et al. (US 5,926,740, previously cited).

Regarding claims 1, 17, 23, and 27, Annapragada discloses forming an extremely low dielectric constant (ELK) film (22) on a substrate (20). The ELK film is used as an interconnect insulating layer, wherein vias (23) are etched into the ELK film using photolithography and conductive interconnect material is deposited into the vias (Fig. 1A-1F; col. 6, ln. 6-col. 7, ln. 30). Annapragada does not disclose forming an amorphous silicon carbide capping layer on the ELK film. Forbes discloses a photolithography process wherein an antireflective coating is deposited between the layer to be etched and the photoresist mask layer. The antireflective coating (ARC) comprises a bottom layer of amorphous silicon carbide (105) and an upper layer of silicon oxycarbide (110) (col. 8, ln. 46-col. 9, ln. 60). Forbes discloses that this antireflective coating is extremely useful in preventing light from the photolithography process from reaching the underlying material, whereby the resolution of the photolithography process is greatly improved, resulting in higher density circuits being able to be formed (col. 3, ln. 26-50). Forbes states that this ARC layer is appropriate to use in the formation of interconnection layers wherein underlying metal is usually highly reflective (col. 3, ln. 40-47). At the time of the invention, it

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would have been obvious to one of ordinary skill in the art to use the ARC film of Forbes when conducting the photolithography process of etching the ELK layer of Annapragada because Forbes teaches that the ARC layer advantageously improves the quality of a photolithography process, thereby allowing higher density devices to be formed. Furthermore, Annapragada states that the material underlying the photoresist includes metal (124) and Forbes discloses that the ARC is especially useful when underlying materials include metal, which is usually highly reflective.

Regarding claims 10 and 11, Annapragada states that the ELK film may have a dielectric constant of less than 2.5 (col. 6, ln. 6-17).

Regarding claim 18, Forbes discloses that the silicon oxycarbide may be deposited using a process in which a silicon-containing precursor (silane), a carbon-containing precursor (methane) and an oxygen-containing process gas (oxygen or nitrous oxide) are reacted in the presence of a plasma (col. 10, ln. 8-20).

Regarding claim 26, Forbes discloses using silane and methane to form the amorphous silicon carbide and does not disclose using any oxygen (col. 9, ln. 16-42).

Regarding claims 19, 28, 29 and 38, Forbes discloses that the silicon oxycarbide layer is graded in a horizontal direction such that it comprises SiC (thus comprising 50 atomic % carbon) in its bottom portion and SiO₂ (oxygen thus comprising 66 atomic % oxygen) at its upper portion, thus the content of carbon in the layer will be graded from around 50 atomic % to 0 atomic % while the oxygen in the layer is graded from 0 atomic % to 66 atomic % (col. 10, ln. 21-40). This means that at some point during the deposition of the layer, the plasma will be oxygen starved (as oxygen flow is gradually increased from 0 sccm).

Claims 3-9, 22, 30, 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. in view of Forbes et al. as applied to claims 1 and 23 above, and further in view of Xu et al. ("BLOkTM – A Low-k Dielectric Barrier/Etch Stop Film for Copper Damascene Applications", previously cited).

Regarding claim 4, Forbes discloses that a number of various methods may be used to deposit the silicon carbide layer, including a method of plasma-assisted chemical vapor deposition using precursors of silane and methane (col. 9, ln. 17-27). Xu discloses a method of forming an amorphous hydrogenated silicon carbide layer (BLOk) that may serve as a capping layer or an etch stop layer on interlayer dielectric materials. Xu states that this BLOk layer is better than conventional silicon carbide deposited using silane and methane because the BLOk layer has a lower dielectric constant, lower leakage current, higher breakdown strength and is easier to etch than the conventionally deposited SiC (col. 2, pg. 109). Xu states that the BLOk layer is copper diffusion resistant (col. 1, pg. 109). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the methods disclosed by Xu et al. to deposit the silicon carbide layer of Forbes because Xu et al. teach that by depositing a silicon carbide layer according to their process, the layer advantageously has a lower dielectric constant, lower leakage current, higher breakdown strength, and is easier to etch than conventional SiC that is deposited using silane and methane.

Regarding claims 3, 5, 6, 7, 35, and 36, Xu does not disclose the BLOk silicon carbide layer to have the limitations recited in these claims. However, Applicant's specification (pg. 10, ln. 19-21) recites that the silicon carbide capping layer of their invention may be BLOk material. Therefore, it appears as though the BLOk layer of Xu will inherently possess these claimed

properties. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971)

“where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on ”); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claim 30, Xu discloses that the BLOk layer has a dielectric constant of less than or equal to 5 (Table 1, pg. 110).

Regarding claims 8, 9 and 22, Xu discloses that when an interlayer dielectric film having a dielectric constant of 2.7 has a layer of BLOk silicon carbide thereon, a combined dielectric constant for a low k interlayer dielectric film and the BLOk silicon carbide capping layer is 3 (col. 2, pg. 111). In the invention of Annapragada, the interlayer dielectric film is disclosed to have a dielectric constant which may be as low as 1.2 (col. 6, ln. 6-9). At the time of the invention, it would have been obvious to one of ordinary skill in the art that the BLOk layer deposited on the interlayer dielectric film of Annapragada having a dielectric constant of 1.2 will have a combined dielectric constant of much less than 3 because Xu discloses that the combined dielectric constant of a BLOk layer and an interlayer dielectric film having a dielectric constant of 2.7 will be 3. Additionally, in reference to claim 22, although Xu does not disclose the BLOk-forming process conditions that are recited in this claim, Applicant’s specification (pg. 4, ln. 29-

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32; pg. 10, ln. 19-21) recites that the silicon carbide capping layer of their invention may be “the commercially available BLOk™ material. Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use the process conditions recited in claim 22, because the method of making this particular material (BLOk) is admitted by the Applicant to be prior art.

Claims 12-16, 24, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. in view of Forbes et al. as applied to claim 23 above, and further in view of Loboda et al. (“Plasma-enhanced chemical vapor deposition of a-SiC:H films from organosilane precursors”).

Regarding claims 12-14, 16, 24, and 25, Forbes discloses an amorphous silicon carbide film that is formed without oxygen, but does not specifically disclose that the film is hydrogenated (col. 9, ln. 16-42). Forbes’ amorphous silicon carbide film is formed by plasma CVD using silane and methane precursors. Loboda discloses a process of forming an amorphous, hydrogenated silicon carbide film for use in semiconductor devices wherein the film is deposited in a plasma CVD process which uses organosilicon precursor gas. Loboda states that it is advantageous to deposit the silicon carbide using an organosilicon precursor instead of silane and methane precursors because organosilicon precursors are much less hazardous than silane, and also because the organosilicon precursor produces a silicon carbide film that has improved purity and process control since the number of process variables are reduced when a single precursor is used (pg. 90). Loboda does not disclose that the source gas for the process contains any oxygen. At the time of the invention, it would have been obvious to one of ordinary skill in the art to deposit the amorphous silicon carbide layer of Forbes using the method of

Loboda because Loboda teaches that using an organosilicon precursor instead of silane and methane precursors is advantageous because organosilicon precursors are much less hazardous than silane, and also because the organosilicon precursor produces a silicon carbide film that has improved purity and process control since the number of process variables are reduced when a single precursor is used.

Regarding claim 15, Loboda discloses that the silicon carbide deposition is carried out at a temperature of 250°C (Table I, pg. 91).

Claims 20, 21 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. in view of Forbes et al. as applied to claims 18 and 23 above, and further in view of Loboda et al. ("Deposition of Low-k Dielectric Films Using Trimethylsilane").

Regarding claims 20 and 31, as stated above in reference to claim 18, Forbes discloses that the silicon oxycarbide may be deposited using a process in which a silicon-containing precursor (silane), a carbon-containing precursor (methane) and an oxygen-containing process gas (oxygen or nitrous oxide) are reacted in the presence of a plasma (col. 10, ln. 8-20). Forbes does not disclose that the silicon-containing precursor and the carbon-containing precursor can be derived from a common organosilane precursor. Loboda discloses a process for making a silicon oxycarbide for use as a dielectric film of a semiconductor device by utilizing an organosilane precursor as a silicon and carbon source and using N₂O as an oxygen source (pg. 145). The silicon oxycarbide produced using the organosilane precursor has a dielectric constant of less than 3.0 (Abstract). Loboda states that it is preferable to form a carbon-doped silicon oxide layer using an organosilane precursor (trimethylsilane) for the silicon and carbon sources instead of using a silane precursor because the trimethylsilane precursor is less dangerous to

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handle than silane (pg. 145; pg. 152). Loboda also asserts that the silicon oxycarbide produced by using the trimethylsilane precursor produces a low permittivity, low stress, high thermal stability film, which is compatible with the requirements needed for the fabrication of the high performance interconnect structures needed for increased processing speed in modern IC designs (pg. 152). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use a trimethylsilane precursor to form the silicon oxycarbide layer of Forbes because Forbes teaches using a silane precursor and Loboda teaches that a trimethylsilane precursor is preferable to a silane precursor because the trimethylsilane precursor is not dangerous to handle and the trimethylsilane can produce a film that has low permittivity, low stress, and high thermal stability.

Regarding claim 21, Forbes discloses that the silicon oxycarbide layer is graded in a horizontal direction such that it comprises SiC (thus comprising 50 atomic % carbon) in its bottom portion and SiO₂ (oxygen thus comprising 66 atomic % oxygen) at its upper portion, thus the content of carbon in the layer will be graded from around 50 atomic % to 0 atomic % while the oxygen in the layer is graded from 0 atomic % to 66 atomic % (col. 10, ln. 21-40). This means that at some point during the deposition of the layer, the organosilane precursor which supplies the silicon and carbon will be at a value of approximately six times the flow of oxygen gas (as oxygen flow is gradually increased from 0 sccm).

Claims 2, 32, 33 and 39-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. in view of Forbes et al. as applied to claim 23 above, and further in view of Xu et al. and Loboda et al. ("Deposition of Low-k Dielectric Films Using Trimethylsilane").

Regarding claims 2, 32, 33, 39, 40, 42 and 43, Forbes discloses that a number of various methods may be used to deposit the silicon carbide layer, including a method of plasma-assisted chemical vapor deposition using precursors of silane and methane (col. 9, ln. 17-27). Xu discloses a method of forming an amorphous hydrogenated silicon carbide layer (BLOk) that may serve as a capping layer or an etch stop layer on interlayer dielectric materials. Xu states that this BLOk layer is better than conventional silicon carbide deposited using silane and methane because the BLOk layer has a lower dielectric constant, lower leakage current, higher breakdown strength and is easier to etch than the conventionally deposited SiC (col. 2, pg. 109). Xu states that the BLOk layer is copper diffusion resistant (col. 1, pg. 109). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the methods disclosed by Xu et al. to deposit the silicon carbide layer of Forbes because Xu et al. teach that by depositing a silicon carbide layer according to their process, the layer advantageously has a lower dielectric constant, lower leakage current, higher breakdown strength, and is easier to etch than conventional SiC that is deposited using silane and methane.

For the reasons stated above in reference to claim 20, at the time of the invention, it would have been obvious to one of ordinary skill in the art to fabricate the silicon oxycarbide layer of Forbes using the trimethylsilane precursor in the manner described by Loboda.

Xu discloses that when an interlayer dielectric film having a dielectric constant of 2.7 has a layer of BLOk silicon carbide thereon, a combined dielectric constant for a low k interlayer dielectric film and the BLOk silicon carbide capping layer is 3 (col. 2, pg. 111). In the invention of Annapragada, the interlayer dielectric film is disclosed to be porous and have a dielectric constant which may be as low as 1.2 (col. 6, ln. 6-9). Loboda discloses that the dielectric

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constant of the silicon oxycarbide produced using the trimethylsilane precursor may have a dielectric constant as low as 2.6 (Table 2). Because the ELK film of Annapragada has a k of 1.2, the a-SiC:H film of Xu has a k of 3.6, and the silicon oxycarbide layer of Loboda has a k of 2.6, it appears that the stack of these films will inherently possess the claimed dielectric constant of “approximately less than 2.5”. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) “where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on ”); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claim 41, using the ARC layer of Forbes in conjunction with the etching process of Annapragada, the capping ARC layer would be in contact with the porous ELK dielectric film.

Response to Arguments

Applicant's arguments filed December 12, 2002 have been fully considered but they are not persuasive.

Applicants traverse the requirement that Figures 1 and 3 be labeled “Prior Art” because “the requirement that Applicants admit that a specific Figure is ‘prior art’ when no such admission has been made is *per se* improper.” However, it is the Examiner’s position that,

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although the specific words “prior art” may not have been used in Applicant’s specification, Applicant’s disclosure is clear that Figures 1 and 3 show only what has been previously known in the art. Referring specifically to Figure 1, the Examiner points out that for examination purposes, it is customary for all art disclosed in the “Background” section of an application to be considered admitted prior art regardless of the terminology used by the Applicant. Referring specifically to Figure 3, the “Brief Description of the Drawings” states, “Fig. 3 is a flowchart of a typical process...” (emphasis added). Additionally, page 7, lines 9-10 of the specification states, “Figure 3 is a flowchart illustrating a basic sol-gel process that HAS BEEN PREVIOUSLY proposed” (emphasis added). Applicant is reminded that 37 C.F.R. 1.56 clearly states that each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the USPTO, which includes a duty to disclose to the Office all information known to the individual to be material to patentability.

Applicant argues that the rejection of Applicant’s claims under 35 U.S.C. 103(a) as being unpatentable over combinations of references including Annapragada (US 6,140,221) and Forbes et al. (US 5,926,740) are improper because “there is no suggestion to modify Annapragada in the manner suggested by the Examiner.” However, the motivation to combine the Annapragada and Forbes references was clearly set out in the previous office action and has been reiterated in the rejections of the claims above. Essentially, Annapragada disclose a process of etching via holes into interlevel dielectric layers using a photolithographic process for the object of depositing metal into these via holes, thereby forming interlevel interconnections. Forbes teaches that when using a photolithography process to perform etching of underlying layers, it is beneficial to use the ARC layer of his invention because, without the use of an ARC layer, photolithography

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processes generally suffer from “notching” problems which cause errors in the etched features.

Forbes states that his ARC layer is applicable to use with a variety of underlying materials including “interconnection lines (e.g., aluminum, copper, refractory metals, or other conductive material)” and “insulators for isolating circuit element or interconnection lines”. Hence, Forbes invention is directed to exactly the same process as is being carried out by Annapragada.

Applicant goes on to argue that, “Since the majority of specific examples of the porous dielectric layers (22) in Annapragada et al. already have some anti-reflective properties, Annapragada et al. teaches away from the modification proposed by the Examiner.” To support the assertion that “the majority of specific examples of the porous dielectric layers (22) in Annapragada et al. already have some anti-reflective properties”, Applicant relies upon the U.S. Patent No. 6,153,504 (Shields et al.). However, Shields only discloses films of nitrides of silicon or nitrides of metals as possessing anti-reflective properties. Annapragada discloses that the porous dielectric layer (22) may comprise a variety of dielectric materials including SiO₂, SiN, SiON, materials formed from TEOS, HSQ, spin-on-glass (including silicate and siloxane materials), and other xerogel dielectrics. Hence, it is clear that contrary to Applicant’s assertion, Shields does not support that “the majority of specific examples of the porous dielectric layers (22) in Annapragada et al. already have some anti-reflective properties.”

Allowable Subject Matter

Claim 37 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The primary reason for the indication of the allowable subject matter of claim 37 is the inclusion therein, in combination as currently claimed, of the limitation of forming the carbon-doped oxide layer such that the silicon and carbon-containing precursors are provided at a rate approximately six times that of oxygen and reacting the precursors in an atmosphere of 1-15 Torr, 100-450°C while supplying a power of 300-600 watts. This limitation is found in claim 37 and is neither disclosed nor taught by the prior art of record, alone or in combination.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (703) 308-5840. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

CLN
March 6, 2003


AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800